A sensitiser must be a depolariser, directly or indirectly. It must be a reducing agent in the broad sense of the term, or it must be changed into one by the action of light. In either case the sensitiser is decomposed by the action of light on the sensitive plate." In support of this position he quotes Bothamley's observation that sensitisers act and a developable image is produced on exposure when the plate is immersed in a powerfully reducing solution, as proving that the dye is not oxidised by exposure as Abney suggested, and shows that the instability of the dye on exposure to light is generally acknowledged as a necessary condition for it to act as a sensitiser. This theory also explains Abney's experiment of exposing a collodion film stained with cyanine to the spectrum, and then coating it with a silver bromide emulsion and developing. The silver bromide was developed to an image over the absorption band of the cyanine, though the silver salt had never been exposed to light.

Among the general conclusions referring to this part of the subject that the author gives in his summing up, the two following have perhaps not been indicated in this abstract, namely:—(1) whether any substance is reduced or oxidised by light depends on the depolariser, and (2) all sensitisers are light sensitive, but the light sensitiveness and sensitising power need not run strictly parallel. Finally, he maintains that the electrochemical theory of light, first proposed by Grotthuss, accounts for all the known facts concerning the action of sensitisers and the action of light upon salts.

In a third chapter (*Journal of Physical Chemistry*, June) Mr. Bancroft deals in a similar way with the action of chlorine and bromine on organic bodies, and the effect of halogen carriers upon the reactions in darkness and in light. He deals with benzene and toluene, and the formation of addition and substitution derivatives, distinguishing in the case of toluene between the replacement of hydrogen in the ring and in the side chain. After summing up the known facts and showing wherein other theories are deficient, he quotes the suggestion of Bruner that chain substitution is due to the bromine molecule and ring substitution to free bromine atoms, the preponderance of ring substitution when the reaction takes place in nitrobenzene as a solvent being "certainly connected with the fact that bromine and a *portion* of the acid of the polybromides is dissociated into ions" in this solvent. Mr. Bancroft agrees with this theory in the main, but carries it further. He assumes that as light of suitable wavelength increases the conductivity of most gases, apparently by forming ions, this dissociation will probably give products (atoms or ions) one half of which will be positive and one half negative—whatever meaning may be attached to these words. If the dissociation products are ions, these words will have their usual meaning. To this assumption he adds four others that are partly new:—(2) That there is a slight reversible reaction between bromine and the positive gaseous ion,

$$Br_2\,Br^+ \rightleftarrows Br_2 + Br^+.$$

(3) That substitutions take place in the ring when the negative gaseous ions are present in excess; otherwise in the side chain. (4) That the addition products of benzene are to be considered as analogous to the chain substitution products of toluene. (5) That there is a reversible dissociation of the halogen carriers with formation of so-called gaseous halogen ions, and whether these ions are positive or negative depends on the nature of the carrier.

Granting these assumptions, at low temperatures and in the dark, $Br_2.Br^+$ will be formed, and therefore an excess of negative bromine ions and ring substitution. With rising temperature the proportion of positive to negative bromine ions increases, and sunlight will increase the dissociation of bromine and of the $Br_2.Br^+$, until the ratio of positive to negative ions approaches unity, and then side-chain substitution takes place. With reference to the fifth assumption, in chlorides of iron, antimony, molybdenum, and aluminium, there is no doubt that chlorine is the negative radical. In iodine monochloride, phosphorus pentachloride, and sulphur chloride, there is evidence of a tendency to form positive gaseous chlorine ions. The author remarks that "it would strengthen the argument if it were possible to show why negative chlorine substitutes in the ring and positive chlorine in the side chain, but I do not see any explanation which can be carried through." A weak point in the argument is the behaviour of aluminium chloride, which Goldschmidt and Larsen have found to behave exactly like stannic chloride as a carrier, although no lower chloride of aluminium is known. But, on the other hand, Turrentine has found evidence of its existence by the electrolysis of a chloride solution using an aluminium anode, though the aluminous salt has not been isolated.

C. J.

BAROMETRIC GRADIENT AND WIND FORCE.[1]

THE relation between the wind and the pressure distribution is a fundamental question of dynamical meteorology. In qualitative form it is expressed by Buys Ballot's well-known law that in the northern hemisphere an observer standing with his back to the wind has the region of lowest pressure on his left. The idea of a quantitative relation between gradient and wind has been made familiar to meteorologists by the classic researches of Guldberg and Mohn. It must, however, be admitted that a comparison of the wind velocity calculated from the pressure gradient by the method given by these authors with anemometer readings has not given entirely satisfactory results. The discrepancies are generally attributed to surface friction, but this quantity has not proved amenable to theoretical treatment, a difficulty which seems to have barred the way for further progress along these lines.

We should expect the effects of surface friction to decrease rapidly with altitude, so that the results of kite and balloon ascents should yield a more suitable material for a comparison of theory and observation than the observations at ground level do. In the report before us, Mr. Gold has used the data accumulated by the Prussian Aëronautical Observatory for such a comparison. From the distribution of pressure he has computed the gradient velocity over Berlin by the formula given by Guldberg and Mohn for each day of the year 1905, and has set beside it the observed direction and velocity of the wind at 1000 metres and 2000 metres above sea-level. The agreement at 1000 metres is surprisingly close. In the preface Dr. W. N. Shaw says of it:—"The general result of the investigation is, in my opinion, to confirm the suggestion that the adjustment of wind velocity to gradient is an automatic process which may be looked upon as a primary meteorological law, the results of which are more and more apparent as the conditions are more and more free from disturbing causes, mechanical or meteorological."

Cases of discrepancy between observed and calculated values may thus be regarded as exceptional, and their special investigation promises an interesting field for research. The observations of wind made at the surface may perhaps also be utilised in this manner if, as Mr. Gold suggests, we prepare a series of coefficients, applicable to the individual stations, which will enable us to allow for the disturbing effects of surface friction.

For work on these lines a simple means of calculating gradient velocities from pressure distribution is required, and a considerable section of the report is accordingly devoted to providing it. Tables have been constructed showing the gradient velocities corresponding with different distances between consecutive isobars on charts of certain specified scales in different latitudes, or, if we prefer it, we have in the frontispiece a convenient scale for reading off the values from the map of the daily weather report or the working chart of the Meteorological Office.

The tables and scale give the gradient velocity on the assumption that the isobars are straight, *i.e.* that the path of the wind is a straight line. If this condition is not fulfilled, a simple correction has to be applied from a second set of tables (or scale of concentric circles) to allow for the curvature of the path of the wind.

There is one point of principle which requires to be mentioned in this connection. In applying the correction,

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[1] Report to the Director of the Meteorological Office on the Calculation of Wind Velocity from Pressure Distribution and on the Variation of the Meteorological Elements with Altitude. By Ernest Gold. (London Wyman and Sons, for H.M. Stationery Office. Price 2*s*. 6*d*.

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it is assumed that the curvature of the isobars is identical with the curvature of the path. This is only true in the special case when the pressure distribution remains constant. If the curvature is small or the pressure distribution is changing rapidly, the difference between the curvature of the isobars and that of the path may be considerable, and the gradient velocity obtained by assuming them identical may be considerably in error. Unfortunately, the determination of the wind path is impossible under these special conditions, and the method of determining the gradient velocity then becomes untrustworthy. Mr. Gold optimistically extricates himself from the difficulty by suggesting a method for determining the motion of the centre of curvature from the difference between the observed velocities and the velocities calculated from the curvature of the isobars and the distance between them.

Two theoretical results arrived at by Mr. Gold are of special interest. He has calculated the time required for air, starting from rest, to acquire the gradient velocity and to adjust its motion to the direction of the isobars. The values found for latitude 50° vary between 4 hours and 16 hours for different conditions of motion, and are thus small compared with an interval such as the day. On another page he gives us an interesting counterpart to the well-known fact that strong winds and steep gradients do not occur near the centres of anticyclones. From the opposition of the accelerations due respectively to the earth's rotation and the curvature of the path, he shows that there must be a limiting velocity and a limiting gradient for anticyclonic areas, if it be granted that the motion of the air adjusts itself to the gradient velocity.

The concluding pages of the report are devoted to a graphic summary of the variation of the different elements with height, as disclosed by the ascents carried out on behalf of the Meteorological Office by Mr. Dines at Oxshott in 1906, and by ascents made at Lindenberg, Berlin, and Blue Hill Observatory, U.S.A.

There is one point to which we should like to refer before concluding. Nobody can take up a paper like the present one, which deals so largely with providing the tools for future research, without being forcibly struck by the disadvantages of our English system of units, at any rate for the purposes of dynamical meteorology. Mr. Gold invites us to measure the distance between isobars for intervals of a tenth of an inch in millimetres. The gradient velocity he gives us in metres per second, and provides a subsidiary table for converting these to miles per hour, the units adopted for wind velocity in all English meteorological publications, even in those specially devoted to the investigation of the upper air. He apologises for the incongruity in a special note, and explains it on the score of convenience. Should our would-be investigator require to chart his results, our map-makers will probably offer him outline maps on a scale of miles to the inch, and a further troublesome reduction will be necessary before he can apply Mr. Gold's tables. We note with pleasure that the maps used by the Meteorological Office for its working charts and daily weather reports are on a scale which is closely related to the natural scale $1:10^7$. We wonder whether other offices use similar scales. The advantage of uniformity in such matters is forcibly brought home by a report such as the one we have described.

THE WORK OF THE PHYSIKALISCH-TECHNISCHE REICHSANSTALT IN 1907.

THE work accomplished by the Reichsanstalt last year, as shown by the annual report of that institution recently issued, appears to be of a character useful both to physicists and to the industries which seek its assistance in elucidating various technical problems.

As regards the physical side of the work, the following researches may be mentioned:—

In accordance with a commission received by the institution, tests were started on the exact measurement of very small pressures (of the order of between 10^{-6} and 10^{-3} mm.), the pressures being determined from the deflection of a metallic membrane of 25 cm. diameter by means of the Fizeau interference method. The absolute velocity of sound in dry air (free from carbonic acid) has been investigated and found to be 33192±5 cm. per second. Dr. Scheel has tested some further materials for expansion between −191° and +16° C. with the Fizeau dilatometer described in the previous year's report, and has obtained results varying from 2120 microns per metre for palladium to −41 microns per metre for quartz glass. Scheel and Schmidt have obtained a much lower value for the refractive index of helium than that found previously by Lord Rayleigh and by Ramsay and Travers, the figures of the former being 1·0000340. Some useful work has been done in regard to the specific heat of nitrogen, CO_2 and water-vapour, up to 1400° C., and experiments to determine the saturation-pressure of water-vapour above 100° C. have been commenced.

In the Electrical Standards Department the variations in manganin resistances have been found to be very slight and the "humidity effect" only just perceptible. Resistance coils are now being wound on metallic spools with longitudinal slots to render them somewhat flexible; in this way it is hoped to make any effect due to humidity practically negligible. Measurements of the wave-length of electric oscillations can be made with an accuracy within 1 part in 1000 for long waves (above 1000 metres), and for shorter wave-lengths the accuracy is within 1 per cent. Other experiments have been made with undamped electric oscillations produced after the Poulsen method by means of an arc burning in oxygen. A research of importance to opticians was carried out in regard to the secular variation of the planeness of surfaces of optical glasses, results being given in the report.

In addition to the researches mentioned, a number of routine tests were carried out in the various departments of the Reichsanstalt, some of these yielding interesting results from a commercial standpoint.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MANCHESTER.—Dr. J. E. Petavel, F.R.S., has been elected professor of engineering and director of the Whitworth laboratories. The following additional appointments have recently been made:—Mr. T. G. B. Osbern, as lecturer in economic botany; Mr. C. H. Lander, lecturer in engineering drawing; and Dr. F. H. J. A. Lamb, senior demonstrator in physiology. Dr. Hans Geiger has been re-appointed to the Harling research fellowship in physics, and Dr. Harry Osborne has been re-appointed a junior research fellow in public health.

THE Department of Agriculture and Technical Instruction for Ireland has issued a circular to committees of management of schools dealing with the question of the liability of school managers and teachers in cases of accidents to pupils in attendance at their schools. In a recent action at law, damages were recovered from a teacher on account of injuries received by one of his pupils in consequence of a dangerous substance, used for scientific experiments, having been left carelessly in the way of his pupils. The department has been advised that teachers may be held accountable for the accidents which may occur as a result of allowing dangerous substances to be within the reach of children so young as to be likely to deal with them in a manner causing injury, or for injuries which may ensue as a result of negligence in allowing these pupils to perform dangerous experiments without providing reasonable safeguards against accident. The object of the circular is to make teachers aware of their responsibility so that all precautions may be taken to guard against accidents to their pupils. Fortunately, it is easily possible to devise suitable school courses of elementary science, including no experiments of a dangerous character, and it may be hoped that this timely warning may interfere in no way with the suitable study of science by boys and girls.

AN address on the teaching of the sciences and the formation of the scientific spirit was given by Prof. Paul Appell, president of the French Association for the Advance-

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